Cancelled 6/22/2000

Invited Paper
Session W2: Satellite Anomalies
Organizer: J. H. Allen

# SPACE ENVIRONMENT EFFECTS ON INTERPLANETARY SPACECRAFT

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Although similar in many respects to the effects observed in the Earth's environment, the extra-terrestrial space environment can pose unique threats to interplanetary spacecraft. Just as at the Earth, discharges, single event upsets, and total ionizing dose have all been observed to have produced anomalies on interplanetary missions. Although often merely of nuisance value at the Earth, these anomalies can have significant impact on an interplanetary mission as the ability to interpret and correct their effects can be seriously compromised by the huge communication distances involved in interplanetary missions and the lack of in-situ environmental information. Typically, the differences between the Earth and, as an example, the jovian radiation environments and their effects are more quantitative than radically different. In some cases, however, such as for hypervelocity micrometeoroid impacts near the Sun where velocities can exceed 500 km/s, new physical phenomena may play a part. This talk will discuss these differences in environments and effects in the context of several recent (Voyager, Magellan, and Galileo) and planned (Pluto Kuiper Express, Europa Orbiter, Solar Probe, and the Interstellar Probe) missions. Although fortunately ultimately survivable, anomalies observed on the earlier missions will be reviewed with emphasis on the mitigation procedures followed and the impacts these design changes had on the subsequent success/failure of the missions. The unique challenges posed by the new missions will also be explored-challenges that range from exceptionally harsh radiation environments to the challenges of truly long duration missions (20-30 years) at extreme distances from the Earth requiring methods for on-board evaluation and mitigation of in-flight anomalies without human intervention. Topics of particular concern will be the charging and radiation environments (both observed and projected), micrometeoroid impacts, and spacecraft charging.